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ABSTRACT

This paper presents findings from the 1998 Working Conference on Mathematics Teaching and Learning in Poor Communities, which examined evidence of effective mathematics education in impoverished communities. The task force highlighted aspects of interventions that were critical to success or failure and examined reform in relation to: student mathematics learning; mathematics teachers and teaching; and school, district, and community contexts. The learning of mathematics by students in poor communities is often limited by: the educational levels of parents; culture-schooling conflicts; low academic aspirations; and remedial instruction that emphasizes practice over problem solving and reasoning. Challenges tied to poverty included: attracting and retaining qualified teachers; student transience; and life circumstances. Many impoverished schools had needs similar to more affluent schools (e.g., organized curricula; appropriate instructional materials, competitive salaries, professional development, stable working conditions, and consistent district and school leadership). Conditions faced by many teachers in districts that have a high proportion of students from poor communities include lower salaries, fewer instructional materials, less professional autonomy, higher student loads, and larger class sizes. Successful high-poverty schools succeeded through the heroic efforts of isolated teachers and administrators. These examples were difficult to replicate broadly. Sample projects show it is possible to develop models to support large-scale mathematics improvement in these communities. Three appendixes present the conference participants and agenda and discussion questions for the conference. (Contains 33 references.) (SM)

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Teaching and Learning Mathematics in Poor Communities

A Report to the Board of Directors of the
National Council of Teachers of Mathematics

Submitted by

Task Force on Mathematics Teaching and Learning
in Poor Communities

Prepared by

Patricia F. Campbell
Edward A. Silver

February, 1999

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Teaching and Learning Mathematics in Poor Communities

Overview

Over the past decade, the National Council of Teachers of Mathematics (NCTM) has been a leader in calling for reform in mathematics curriculum, instruction, and assessment in order to improve the mathematics achievement of all students. Through its published standards and its official policy statements, NCTM has asserted that mathematical power must be considered the right and the expectation for every child. There are encouraging signs that mathematics is becoming accessible to larger numbers of students. For example, more students are enrolling in and successfully completing high school mathematics courses, more instructional time in elementary classrooms is being devoted to mathematics, and student mathematics proficiency has increased with respect to basic mathematical knowledge and skills (National Science Foundation, 1996). Yet all the evidence is not positive. As the results of the Third International Mathematics and Science Study (TIMSS) have demonstrated, when compared to many other countries, overall levels of mathematical proficiency are low in the United States, especially after grade 4 (USDE, 1997). Further, a close examination of student achievement data at grades 4, 8, and 12 from the National Assessment of Educational Progress (NAEP) indicates a persistent performance disparity among subgroups defined by socioeconomic status and race/ethnicity (Mullis et el., 1994).

Variations in students' mathematics achievement have long been associated with the demographic variables of socioeconomic status and race/ethnicity. The mean academic achievement of students registered in schools that enroll a high percentage of students who live in poverty is significantly lower than the mean academic achievement of students from schools in more affluent communities (Abt Associates, 1993). Although racial minority students have narrowed the achievement gap in standardized test performance and on the NAEP, a substantial difference still remains (Congressional Budget Office, 1987; Mullis et al., 1994). On standardized assessments, there is a consistent, persistent pattern of differential mathematics achievement favoring affluent and white students over poor students and children of color (except Asians). Moreover, the reductions in racial/ethnic group performance differences have generally come from improvements on those sections of tests related to factual knowledge and calculation skills. Little change has been found for portions of tests measuring higher-level mathematical outcomes (Secada, 1992). That is, although the differential performance gap among black, Hispanic, and white students has been closing over time on tasks that assess basic procedural knowledge and skills, substantial performance differences remain on tasks that assess conceptual understanding, mathematical reasoning, and problem solving.

In 1990, 40% of the nation's poor were school aged (Hodgkinson, 1990). This is not simply an artifact of the urban inner city. Recent poverty rates for rural areas exceed those for urban areas (Hodgkinson & Obarakpor, 1994). The poverty rate is projected to increase until "by the year 2000, school-aged youth will comprise half of the nation's poor, far beyond anything the United States has ever faced, even during 'the Great Depression' of the 1930s" (Toepfer, 1997, p. 28). Furthermore, the challenge to improve the content and character of academic instruction in schools and districts serving economically disadvantaged communities is likely to increase due to cuts in social services and heath care within those communities. If the broad general educational goals of increased access and achievement for all students are to be reached, it is critical to address the teaching and learning of mathematics in poor communities. Because of its role in promoting improved mathematics education for all students, NCTM is uniquely positioned to focus attention on the important matter of teaching and learning of mathematics in poor communities. Thus the NCTM Board of Directors established a Task Force on Mathematics Teaching and Learning in Poor Communities.

Charge to the Task Force

In February, 1997, the NCTM Board of Directors charged that a Task Force on Mathematics Teaching and Learning in Poor Communities be appointed to:

- assemble a group of individuals who will share findings and analyses with each other and make recommendations to the Task Force regarding what is known and not known about mathematics teaching and learning in schools and districts serving poor communities; and
- write a report for the NCTM Board of Directors addressing the results and/or implications of the interchanges catalyzed by the interactions characterized above.

The first charge was addressed via an invitational working conference organized by the Task Force and sponsored by NCTM. This report serves to fulfill the second charge.

The Task Force defined its work as involving both knowledge dissemination and knowledge generation. A working conference is limited in what it can accomplish with respect to a charge of sharing findings and framing recommendations, but such a conference can initiate a longer process. In particular, a conference can serve to assist in the compilation of ideas about what is known and what needs to be known. Thus, one aspect of the work of the conference was the identification of evidence of effective mathematics education in schools serving poor communities and the specification of approaches that have been used successfully to address the challenges faced by

these schools. In this way, educators might become more familiar with some aspects of what is known and what is not known about the process and outcomes of mathematics instructional improvement efforts in schools and districts that face the challenges and constraints of poverty and related societal pressures.

Structure of the Conference

On June 7–10, 1998, an invited group of educators met in Chicago, Illinois, to participate in the Working Conference on Mathematics Teaching and Learning in Poor Communities (see Appendix A). The conference provided a forum for participants to discuss evidence of effective mathematics education in schools serving poor communities and approaches for addressing the challenges faced by these schools. Beyond merely considering "what works," participants were encouraged to probe the circumstances under which those interventions were or were not effective, the aspects of interventions that appear to be critical to their success or failure, and the nature of evidence of success.

The conference was organized around three major themes: (1) student learning of mathematics; (2) mathematics teachers and teaching; and (3) school, district, and community contexts. A substantial portion of time at the conference was devoted to each topic, including a plenary session speaker for each topic. Walter Secada was the plenary speaker addressing student learning. Gloria Ladson-Billings offered the plenary address on teaching. Jeannie Oakes examined the context of education in her plenary session. Following each plenary speaker, two parallel small group discussion sessions convened to address the issues associated with the topic of the plenary hearing (see Appendix B for the conference agenda). Within the theme of student learning of mathematics in poor communities, conference participants addressed expectations and support of students, evidence and assessment of students' learning, and mathematics content relevant to students' experiences and needs. The discussion of mathematics teachers and teaching in poor communities encompassed teaching methods and materials, teacher preparation and qualifications, and teachers' professional development and support. Participants addressed school, district, and community contexts for mathematics teaching and learning in poor communities through a discussion of school, district and community leadership, curricular policy, and parent and community involvement.

Findings

The participants brought considerable yet diverse knowledge and experience to the meeting with associated costs and benefits. Because most of the participants had extensive experience working in poor communities, there was much to be gained by listening to each person relate personal experiences. The diversity represented in the experience base of the invited participants made this particularly valuable. However, this diversity also confounded efforts to find a common language that would support a serious, substantive analysis of the claims and arguments proposed by participants. The plenary session speakers were critical as they helped establish an analytic and evidence-based tone for the entire conference. Further, the questions in distributed pre-conference materials served to focus attention in specific directions during the small group discussions (see Appendix C).

In general, there was a substantial agreement about the need to continue efforts to improve the mathematics teaching and learning of students in poor communities. However, at the same time, there was a great amount of disagreement stemming from differing philosophies, community contexts, prior experience, and semantics. This disagreement served to make consensus difficult, and it highlights one aspect of the work that still needs to be done before substantial progress can be made in addressing the needs of teachers and students in poor communities.

Student Learning of Mathematics

Influence of Social Condition, Culture and Goals

Social condition, social tradition or culture, and social goals influence student learning. For example, poverty and the educational level of parents are two social conditions that impact learning. Poverty limits the out-of-school educational experiences and materials that students encounter, affecting both the prior knowledge that students bring to the classroom and access to the tools that students may need to accomplish assigned tasks. Similarly, poverty is often correlated with unstable housing patterns, thereby increasing student mobility and resulting in gaps in learning. Parents' educational level is associated with student learning as parents trust, desire or demand that schools stimulate their children's academic accomplishments, accomplishments that are typically expected to match or exceed those of the parents.

Parents also expect schools to support their children's emergence as contributing members of their community or culture. However, a students' social traditions or culture may either coincide or

conflict with classroom norms for student activity, student conduct, and student-teacher interactions (Delpit, 1988; Malloy & Malloy, 1998). This may occur in urban settings and in isolated rural locations. Culture-schooling conflicts have been noted in schools serving the children of recent immigrants from other nations, schools enrolling Native American students, and schools enrolling African American students. When classroom norms and students' cultural traditions compete, two differing positions may emerge within schooling. One perspective is to expect students to assimilate the prevailing culture of the school. It is the student who must adapt. If the student is not able or willing to function in the non-receptive culture of the school, student learning is curtailed and alienation or resistance may occur (Gordon & Yowell, 1994). While cultural assimilation of the dominant norms for schooling is viewed by some as a indicator of success in the classroom, it may in fact cause students to lose or discard their traditions, depending on whether the student can shift between two cultures. Another perspective is to view students' diverse social perspectives as strengths to be accommodated in the classroom. In this case, the intent is to adapt the prevailing norms in the classroom to accept the traditions and approaches of the students. In the first position, student learning is influenced by the students' ability to adapt and to function within two cultures. In the second approach, student learning is influenced by the schools' facility in fostering academic growth within differing social traditions.

Social goals also influence student learning as there are differing expectations or aspirations for education. It may be that education is perceived as important because learning is valuable for its own sake. In contrast, education may be perceived as being irrelevant to the conditions that challenge a community or family. Demographers refer to parents' aspirations for their children and to family attitudes toward education as "home atmosphere." Academic performance is highly correlated with "home atmosphere"; it is this association that accounts for the weak correlation between isolated measures of poverty status and student achievement. While a family's economic condition may change temporarily due to illness, between-job status, or loss of income while pursuing an educational or vocational credential, the family's "home atmosphere" persists. However, students who experience long-term poverty are significantly more likely to have diminished academic achievement, even after controlling for other demographic characteristics of the students (Orland, 1994).

In many communities, K-12 schooling is perceived as a critical step in the process of earning a college diploma, with inherent expectations for future economic and social benefits. However, in rural communities, adolescents frequently experience conflict between career aspirations and their preferences for a future residential location. This is because both adolescents and adults in rural communities recognize that the economic benefits associated with a college diploma may only be

accessible at locations removed from the parents and family who reside in a local area. Indeed, a recent study indicated that, by age 25, half of all rural college attendees had not returned to their home community (Gibbs, 1995). It is not unusual for rural adolescents, particularly male adolescents, to decide there are substantial risks associated with "too much education" leading to lower educational aspirations, hesitancy or delay in pursuing college entry, lessened motivation for secondary schooling, and worry or anger regarding the future options (Hektner, 1995). Nevertheless, a K-12 or K-16 education may be the critical mechanism for transferring those skills that are deemed critical for employment and economic survival into a community, with the intention of stabilizing and maintaining the viability of that community.

Influence of Content

For many students, mathematics often serves as a stumbling block to academic success. This is often a factor of: prior negative experiences; content that is distanced from students' experiences; an unfocused, repetitive curriculum; and a lack of understanding about the role and power of mathematics. For example, consider the findings of the TIMSS. As compared to the curricula of other countries, the content taught in U. S. eighth-grade mathematics classrooms is at a seventh-grade level. Topic coverage in U. S. eighth-grade mathematics classes is not as focused as in Germany and Japan. U. S. mathematics classes require students to engage in less high-level mathematical thought than classes in Germany and Japan. U. S. mathematics teachers' typical goal is to teach students how to do something, while Japanese teachers' goal is to help them understand mathematical concepts (USDE, 1997).

It is evident that the mathematics content that is taught in schools is an important and critical factor impacting the future success of students in mathematics. School mathematics content must be worthwhile in nature, have mathematical integrity and rigor, and provide options for students. The mathematics content, however, should be the same content for students in poor communities as for those from more affluent communities—a separate content for students in poor communities is not advocated nor supported. This is not the current status. Secondary schools with high concentrations of non-Asian minority students living in poverty offer students fewer available choices for mathematics courses with fewer opportunities for registration in advanced mathematics courses than do more economically advantaged schools (Oakes, 1990). High school students in rural schools and in inner city schools are less likely to be enrolled in advanced mathematics courses (advanced algebra, analytic geometry, trigonometry, or calculus) than are students in suburban schools, even after controlling for the size of the school (Ballou & Podgursky, 1998). It is

critical that schools in rural areas and schools that do not have sufficient enrollments in advanced mathematics courses learn how to effectively tap the potential of distance learning and the Internet.

The learning of mathematics by students in poor communities has been limited, not only by the availability of courses, but also by the focus or perspective of the instruction. Too often the curriculum in high-poverty classrooms is based on the "conventional wisdom" that students are deficit and that the curriculum should follow a fixed sequence of lessons, emphasizing practice and moving from basic to more advanced skills without ever addressing problem solving or reasoning. In this approach, what is taught in mathematics is differentiated by a prior evaluation of student proficiency so that remedial instruction can be provided to supplement the "known" skill deficiencies of the students (Knapp, 1995). This approach further limits student learning. The mathematics to which students have access should not be a factor of where they live or the social conditions to which they are born. If the mathematics is deemed worthwhile to learn, then students in poor communities should have the same access to that mathematics as those in affluent communities.

This worthwhile mathematics must include high levels of expectations for students. However, along with high expectations, students in poor communities need support to maximize learning. Support for students may occur in the classroom environment where students have opportunities to learn. As described in the *Professional Standards for Teaching Mathematics*, teachers provide support for student learning by insuring that students engage in worthwhile mathematical tasks, that teachers and students engage in mathematical discourse, and that the learning environment fosters the development of students' mathematical power (NCTM, 1991). Support for students may also occur in out-of-the-classroom structures. There is a large body of knowledge about the additional support systems that best serve students. Generally, these support structures need to be student centered and, as a key feature, involve the presence of adults. Many models of successful support structures depend on parent and community support. However, the lack of home or community support should not serve as an excuse to not provide the support structures required by students.

Influence of Assessment

The success of students is often measured in terms of achievement on standardized assessment measures. Students in poor communities are subject to the same assessments as other students. It is important that students from high poverty schools perform well on these assessments as these schools are often subject to scrutiny. However, in the three centers of poverty, namely, rural, urban, and Native American, there are distinctions in the source of and motives for the scrutiny. In urban

settings, the source of this scrutiny comes from both state and local sources, often from politicians and the business sector. Usually, the motivation behind the scrutiny is political or economic—education is a product for which the public pays, and there is a genuine concern that the public receives that for which it pays. In rural settings, there is little local academic scrutiny because of a lack of knowledge by parents. However, driven by an economic motive, rural schools are scrutinized by the state. For the Native American poor, there may be three types of schools that support the education of the community— local schools, state-supported schools, or schools supported by the Bureau of Indian Affairs. These three sources of support also become unique sources of scrutiny, and each may have a different motive. A challenge to those who work in schools that serve the poor is to find a way to respond to these assessments in order to permit examination of achievement and growth, while also responding to the source and motivation of the scrutiny.

The real challenge for these schools, however, is that of providing a worthwhile mathematics program while facing the limitations of standardized assessment. Often, standardized tests drive curriculum and instruction. The pressure for successful results often means schools are forced to focus on the assessments, and the content of those assessments determines the content taught in the classroom. This means that the minimum expectation for students becomes the goal of instruction. In essence, this illustrates the most negative aspect of standardized testing.

However, assessments can have very positive effects on schools. When used properly standardized assessments can inform instructional decisions, particularly standards-based assessments as opposed to norm-referenced assessments. However, this requires an understanding on the part of schools as to how to use data and an assumption that schools are provided with the requisite data. For the most part, data are often misinterpreted, misused, or, in extreme cases, abused. Hence this defines the dilemma that schools face. How do schools respond to the pressures of assessments while at the same time providing a strong mathematics program—not allowing the assessments to drive the curriculum, but rather using the assessments to support and inform instruction. It is necessary to acknowledge that standardized assessments are not adequate to measure appropriately and correctly the complete mathematical understanding of students—neither in the content assessed, the depth of mathematical understanding measured, nor the manner in which the mathematics is assessed. Although these assessments do not adequately reflect the all goals of mathematics instruction, these assessments generally do reflect a subset of the mathematics curriculum, and students should be able to complete them adequately. Yet, the curriculum should not be defined by these assessments, and these assessments cannot be allowed to define expectations. The need to respond to current assessment systems is often viewed as an excuse to adhere to a skills-based curriculum and

instructional approach. Poor communities are faced with the need to better improve content and instruction in mathematics, and assessment often serves as an impetus for these shifts in content and instruction. Yet, these communities must fight for better assessments, while at the same time, find ways to respond to those assessment systems that are currently in place. The question that poor communities now face is how to find or develop better assessment systems, and in turn, shift their content and instruction, while raising the performance levels of students on current assessments.

Mathematics Teachers and Teaching

Teachers in urban and rural schools of poverty face enormous challenges. Both urban and rural teachers address constraints within their schools that limit their instructional choices, such as working with inadequate resources and accessing limited professional development opportunities. Similarly they confront common limitations from outside their schools that impact their students' readiness for instruction, such as inadequate health care or nutrition. Yet there are differences. Urban teachers may work in dangerous neighborhoods with highly mobile students who are culturally diverse and speak a cacophony of languages. Rural teachers may work in schools that are the central focus of the surrounding community with students who have lived in that region all of their lives, as have their parents and grandparents. Indeed, a teacher in a rural school may even have taught a current student's grandparent. However, whether in an urban or rural setting, it is highly likely that a high-poverty classroom will challenge a teacher's own culturally based perspectives of what it means to teach and of what students should do to learn.

While urban centers have been the frequent target of calls for teacher change, most of the past reform efforts in mathematics education bypassed rural America. However, in 1987, Congress charged the regional educational laboratories to undertake a "rural initiative," focusing on improving instruction and building the capacity of state and local district personnel. This commitment was expanded in 1994 as the NSF-instituted Rural Systemic Initiatives whereby rural "regions" of collaborative partnerships across school districts were formed to promote a vision of educational reform in mathematics and science (Harmon & Blanton, 1997).

Implementation of reform faces greater challenges in districts composed of schools of poverty than do other school systems, including how to effectively teach a core mathematics curriculum to students of limited English proficiency. However, instructional approaches that emphasize conceptual understanding of mathematical ideas and procedures within a broader range of content offer the most promise for effective mathematics instruction in schools of poverty (Knapp, Marder, Zucker, Adelman, & Needels, 1995). Effective teachers organize their instruction to build on

students' prior knowledge as they promote and maintain solid classroom interactions with their students (Ladson-Billings, 1995). Classroom discourse can then be a mechanism to promote mathematical analysis, reflection, verification, and justification. This is in contrast to what Haberman (1991) describes as the "pedagogy of poverty." Haberman contends that in schools of economic need, the "pedagogy of poverty" defines what teachers do, what students come to expect, and what both parents and the public of that community presume. The issue is not the occurrence of any one of these instructional acts within a classroom, but rather the limiting impact of the consistent reiteration of these actions to the exclusion of any other approach. As defined by Haberman, these "core functions" are:

- giving information,
- asking questions,
- giving directions,
- making assignments,
- monitoring seatwork,
- reviewing assignments,
- giving tests,
- reviewing tests,
- assigning homework,
- reviewing homework,
- settling disputes,
- punishing noncompliance,
- marking papers, and
- giving grades. (p. 291)

Current and past student achievement data verify the ineffectiveness of this approach to instruction. However, if teaching for mathematical understanding, with a focus on problem solving, reasoning, and making sense, is to occur in schools of poverty, the inadequacy of the "pedagogy of poverty" must be confronted and discussed openly with teachers. Further, teachers in high poverty schools need to learn how to maximize student learning in heterogeneous settings without resorting to tracking as this will limit further the opportunities available to students

There are school-based teacher enhancement efforts in mathematics, within urban schools that serve low-income and high-minority students that have yielded instructional change with increased student achievement (Campbell, 1996; Silver & Lane, 1995; Silver & Stein, 1996). Thus, there are successful models for changing mathematics teaching in order to increase student learning in poor communities. Successful reform efforts are characterized by: concentrated teacher enhancement sessions designed to enroll the entire mathematics teaching staff in the school; attention toward increasing the teachers' own mathematical content knowledge; examination of what is known about students' learning of selected mathematical topics; concurrent examination of instructional approaches or tasks for those topics in order to develop teachers' mathematical and pedagogical content knowledge; follow-up instructional support and mentoring during the school year;

opportunity for grade-level or department planning with continued professional development and interaction; and local administrative support of the reform effort. In urban areas, follow-up instructional support has been on-site while in rural areas the Internet has supported collaboration with colleagues and experts in a few efforts (Rogan, 1995; Yap, 1997). More study is needed to characterize the nature and longevity of the implementation of mathematics reform efforts in classrooms serving poor communities, particularly in rural areas, and to examine the implications of that reform on student achievement in mathematics.

The issue is not whether mathematics teacher enhancement can address student learning in schools of poverty, the issue is how to support and maintain teacher enhancement efforts and how to address the problem of scale. In terms of teacher enhancement, both urban and rural schools require sustained supportive leadership in order to establish a climate of change and to set the pace and maintain the vision for what can be accomplished in schools and what can be expected of students. At the same time, policies and programs need to be developed by state departments of education and higher education institutions to attract, prepare, support, and retain talented mathematics teachers for teaching in high poverty schools. The problem of scale has two forms. In urban areas, scale refers to the large numbers of schools and teachers eligible for enhancement, with associated high mobility within both the instructional staff and the student population. In rural areas, scale refers to distance, with isolated teachers and schools raising issues of access to enhancement and follow-up support.

School, District and Community Context

"As matters now stand, the students in greatest need of the best teaching are the least likely to get it."
(Darling-Hammond with Green, 1994)

Teaching Conditions

Mathematics education reform in poor communities is challenged by the conditions of teaching. Districts that have a high proportion of students from poor communities generally offer teachers less salary, fewer instructional materials, less favorable teaching conditions, less professional autonomy, higher student loads, and larger class sizes than do districts in wealthier locales. One-third of the teachers in high poverty schools teach without even a minor in the subjects that they teach (Darling-Hammond, 1997). While state mathematics standards and NCTM documents have played a role in the reform of mathematics curriculum frameworks and in the definition of learner expectations for many districts, obstacles still exist impeding the successful implementation of these

frameworks in poor communities. These obstacles include: (1) frequent changes in superintendents or principals with associated changes in curricular focus and diminishing support for prior initiatives, including both the successful efforts and those endeavors that have not been given enough time to complete their implementation in order to evaluate effect; (2) a large percentage of teachers in high poverty schools teaching without proper credentials with associated adverse implications for student learning and for teacher turnover yielding staffing decisions without regard to teacher strengths; and (3) geographically isolated small staffs or economic instability resulting in recently enhanced mathematics teachers being reassigned to teach a different subject or to teach in a different school in the following year.

Economic Implications

Although lagging student performance and depressed economic conditions are common to both urban and rural poor communities, differences exist. Local tax structure in rural areas affects funds for education. The Children's Defense Fund has noted that it is more costly to provide equal educational opportunities in rural locations as compared to urban districts, given the economics of scale. Rural districts have to pay higher costs per course because funds are typically determined on a per-student basis. Rural states typically have inadequate cost equalization formulas based on population density, so local taxes are critical for funding education. The resulting lack of funds decreases access to quality mathematics and advanced placement course offerings (Children's Defense Fund, 1992). High school dropout rates are higher in rural areas than in metropolitan areas. Teacher turnover is higher in some areas depending on cultural, economic and geographical conditions. For example, for cultural reasons, many schools on Native American reservations do not adjust salaries for teachers with advanced degrees. Thus, retention of teachers with master's degrees in these schools is difficult. Rural communities face the added challenge of geographic isolation that limits access to community resources and support systems that enhance student and teacher performance (DeYoung, 1994). Further, schooling that promotes individual achievement as necessary for economic success seems in many cases to undercut the importance of a sense of place and the kinship bonds of rural families; this is especially a critical concern for schools serving Native American communities.

While poor school systems lack economic resources, they can make a significant impact on curricular reform, especially that which involves the teaching and learning of mathematics. With proper assistance and support, parents, teachers, principals, and community stakeholders can become involved in the development of a vision that stresses the importance of mathematics to the

community and its citizens. Simultaneously it is necessary to develop a leadership plan for change which focuses the use of the available resources on the implementation of the reform.

Nurturing leaders in the school and in the community helps maintain local buy-in of the reform and sustain long-term efforts. To effectively bring about reform, however, high-poverty districts need access to information and expertise that are readily available in more affluent districts. District personnel need to access models or exemplars of success, models for staff development, high quality learning resources for mathematics (including instructional materials), on-going technical assistance, and follow-up support. At the school level, assistance is needed to help teachers and administrators develop the knowledge and skills necessary to make sound decisions about mathematics curriculum, instruction, assessment, and other critical issues. Moreover, information technologies can provide tools that enable teachers, students and community members, regardless of their geographic location and socioeconomic status, to access resources, information, experts, mentors, and colleagues. The rapid growing capabilities of high-speed networks and telecommunication systems give rural regions their first real potential to overcome the persistent isolation and lack of opportunity resulting from geography and poverty (Harmon & Blanton, 1997).

Parent Involvement

School and community-based action, assistance, and support should be based on locally identified needs. Parental involvement programs work best in communities when they respond to particular features of the communities that they serve. Support structures can help bring parents into the education process and better help them know how to support their children. Title I legislation spells out responsibilities of the school to the family and the family to the school, but it is necessary to develop local strategies for supporting parents and sustaining parental involvement in the schools.

Some schools have established successful parent professional development projects that assist the parents in understanding how state or local educational accountability outcomes or standards relate to their children. One model for developing parental awareness of standards-based curriculum is to hold Math Nights. These are evening sessions where parents become familiar with the expectations that the district or school has for mathematics at each grade level and learn about the meaning of different forms of assessments. Another vehicle for building parental understanding of the approaches being used in mathematics instruction is to hold Family Math Nights where parents experience mathematics activities within centers where their children serve as docents directing and explaining the center activity. Yet a third model for parental involvement is being developed in the NSF-funded MARS Project, where children come with their parents or guardians to after-school

sessions that use multicultural literature as a context for mathematical problem solving. In this model, teachers demonstrate reading comprehension questioning strategies as a story is read aloud to the children and their accompanying adults. Then the teachers use the context of the story as the setting for engaging parents in working on mathematics problems with their children (Strutchens, 1998). A third model is Family Connect, a program for parents of children in pre-school through early primary grades.

Policies

Policies relative to curriculum, staffing, and recruitment policies can make important differences, particularly in poor communities. These include policies that:

- raise the awareness of regional leaders, superintendents and principals of the importance of inquiry and standards-based mathematics for the welfare of the community;
- converge resources for the staff development, materials and technological tools that are necessary for implementation of an adopted curriculum;
- provide follow-up professional development in subsequent years after the launching of a mathematics initiative;
- provide for professional support mechanisms such as common planning time for teachers, mathematics mentor teachers, teacher networking that brings teachers together either electronically or in person, and university courses focusing on teaching the curriculum;
- design aggressive recruiting programs to hire new teachers who have received pre-service training for teaching in high poverty schools;
- inform newly hired principals and superintendents of recent initiatives that should be permitted sufficient time for implementation with the expectation that the new administrators will meet with the leaders of the initiative and monitor the effectiveness of the implementation;
- create in school buildings a climate that fosters good teaching, with no tolerance for unprofessional practice;
- create in school building a climate that fosters professional tenacity whereby teachers and administrators work with students, parents, and community leaders to assure that each student has the support needed to meet any intervening challenges that may hinder that student's achievement;
- allow five years for a new initiative to bring about change;

- support new teachers by not assigning them to the most difficult classes to teach, by not scheduling them with too many preparations, and by not leaving them to teach in isolation without some of the support mechanisms listed above;
- create academic support systems for students and parents; and
- provide access and technical assistance to high quality curriculum resources for classroom instruction and professional development.

Summary

In poor communities today, constraints from both within and outside schooling are affecting the quality of the education students receive. As a consequence, the overall mathematics achievement of students who live in poverty is low, and it is significantly lower than that of students from more economically affluent communities. Schools serving low-income communities face many challenges that are tied to those conditions of poverty with which students and their families live. For example, it is a challenge to attract and retain well-qualified teachers; transience within the student population disrupts continuity of instruction and learning; and challenges in the lives of students due to inadequate income, transportation, health, and safety often make it difficult for students to focus on an academic agenda. Nevertheless, it is striking that many of the needs of mathematics education in these schools are similar to those of schools in more affluent communities. For example, all schools need an organized curriculum addressing significant mathematics with depth and clarity; appropriate instructional materials to address the curriculum goals; competitive salaries and a program of sustained and supportive professional development opportunities for teachers, including time for planning and collegial interaction; stable school conditions that are conducive to teaching and learning, including reasonable class size and administrative support; programmatic sensitivity to the culture and goals of the communities being served; in-school and out-of-school support structures for students; appropriate assessments that can inform instructional decisions; and consistent district and school leadership in adopting and implementing educational policies and practices that support teaching and learning. Providing these features of mathematics education in schools serving the children of poverty is a major challenge for a nation that prides itself on educational opportunity and speaks of equity and justice for all of its citizens.

There are notable cases of schools in high-poverty communities that have succeeded, at least for a time, through the efforts of heroic, isolated teachers or administrators. Yet, these examples are almost impossible to replicate broadly. The solution to the challenges of teaching and learning mathematics in poor communities is not to search for such heroic individuals, but rather to promote

widespread efforts that support educational quality and educational justice within schools and school districts that serve students who live in poverty. Examples of projects and pioneering schools and districts suggest that it is possible to develop models that will support large-scale improvement in mathematics teaching and learning in schools that serve students in low-income communities. As these examples suggest, it is critical that the teachers and students who work in schools located in poor communities have the components of schooling noted above, and that teachers, administrators, students, parents, community leaders, and higher education partners work together to raise the likelihood that students will become engaged in their education and will learn mathematics.

The reforms that are needed are expensive, and some may question whether the cost is justified. Yet, we can ill afford not to undertake such efforts. As the gap between the "haves" and the "have nots" grows in our stratified society and as the rate of poverty among school-age youth increases, we must take steps to address the quality of education in the schools that serve students from low-income communities. Further, since mathematical competence is an important qualification for many educational and employment opportunities, attention to mathematics education in these schools is especially critical. A duality of attention and action is essential in order to realize the larger national goal of excellence in mathematics education because there can not and will not be excellent mathematics education in the nation unless and until we have quality mathematics education in every classroom.

The NCTM Board of Directors must be commended for convening a conference to address issues related to the teaching and learning of mathematics in poor communities, yet there is no single action that the conferees can propose to NCTM as a solution to this profoundly critical challenge facing mathematics education. Discussion at the conference deepened the participants' understanding of the nuances and complexities of the issues inherent to mathematics teaching and learning in poor communities, as well as clarifying those aspects of interventions that seem to be critical for addressing educational reform. These elements and policies have been noted in this report. Further, the conferees were unanimous in the view that NCTM should continue to take steps to address the teaching and learning of mathematics in poor communities.

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Appendix A

Mathematics Teaching and Learning in Poor Communities: A Working Conference

Participants

Mathematics Teaching and Learning in Poor Communities:
A Working Conference

Participant List

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Appendix B

Mathematics Teaching and Learning in Poor Communities: A Working Conference

Agenda

Mathematics Teaching and Learning in Poor Communities:
A Working Conference

The National Council of Teachers of Mathematics
Hyatt Regency O'Hare, Chicago, Illinois
June 7–10, 1998

Agenda

June 7, Sunday

6:00—7:00 PM **Reception and Registration**
Turnberry Room - Conference Level

7:00—9:00 PM **Dinner and Plenary Session**

Welcome
Glenda Lappan, President of NCTM

Overview
David Molina, University of Texas at Austin
Chair, Task Force on Teaching and Learning Mathematics in Poor Communities

Opening Plenary Session
Kent McGuire, Consultant to the Department of Education

June 8, Monday

7:30—8:30 AM **Continental Breakfast**
Turnberry Room - Conference Level

8:30—9:00 AM **Plenary Session: Student Learning**
Walter Secada, University of Wisconsin - Madison

9:00–10:20 AM **Discussion: Student Learning**
Turnberry Room - Conference Level
Spyglass Hill Room - Conference Level

10:20–10:40 AM **Break**

10:40 AM–12:00 PM **Discussion: Student Learning (cont.)**
Turnberry Room - Conference Level
Spyglass Hill Room - Conference Level

12:00–1:20 PM **Lunch - Top Lobby, Level B**

1:30–2:00 PM **Plenary Session: Mathematics Teaching**
Turnberry Room - Conference Level
Gloria Ladson-Billings, University of Wisconsin - Madison

2:00—3:20 PM **Discussion Session: Mathematics Teaching**
Turnberry Room - Conference Level
Spyglass Hill Room - Conference Level

3:20—3:40 PM **Break**

3:40—5:00 PM **Discussion Session: Mathematics Teaching (cont.)**
Turnberry Room - Conference Level
Spyglass Hill Room - Conference Level

(Dinner on your own.)

June 9, Tuesday

7:30—8:30 AM **Continental Breakfast**
Turnberry Room - Conference Level

8:30—9:00 AM **Plenary Session: Context**
Jeannie Oakes, UCLA

9:00–10:20 AM **Discussion: Context**
Turnberry Room - Conference Level
Spyglass Hill Room - Conference Level

10:20–10:40 AM **Break**

10:40 AM–12:00 PM **Discussion: Context (cont.)**
Turnberry Room - Conference Level
Spyglass Hill Room - Conference Level

12:00–1:20 PM **Lunch - Top Lobby, Level II**

1:30–3:30 PM **Poster sessions by conference attendees**
Turnberry Room - Conference Level

3:30–4:00 PM **Break**

4:00–5:00 PM **Synthesis of Discussion**
Turnberry Room - Conference Level
Ruth Cossey, Mills College

5:00-6:00 PM **Reception and Further Discussion**
Turnberry Room - Conference Level

(Dinner on your own.)

June 10, Wednesday

7:30—8:30 AM	**Full Breakfast** Turnberry Room - Conference Level
8:30—9:00 AM	**Plenary Session: Looking Ahead and Facing Challenges** Ed Silver, Learning Research and Development Center Pat Campbell, University of Maryland
9:00–10:20 AM	**Discussion: Looking Ahead and Facing Challenges** Turnberry Room - Conference Level Spyglass Hill Room - Conference Level
10:20–10:40 AM	**Break**
10:40–11:40 AM	**Discussion: Looking Ahead and Facing Challenges (cont.)** Turnberry Room - Conference Level Spyglass Hill Room - Conference Level
11:40–12:00 PM	**Summary and Next Steps** Turnberry Room - Conference Level David Molina, University of Texas at Austin
	Closing Comments Gail Burrill, Past President, NCTM
12:00 PM	**Adjourn**

(Box lunch available for participants.)

Appendix C

Mathematics Teaching and Learning in Poor Communities: A Working Conference

Discussion Questions

Mathematics Teaching and Learning in Poor Communities: A Working Conference

Discussion Questions

Student Learning

Within the strand of student learning of mathematics, three major areas of concentration have been identified. Initial questions to be addressed at the conference, organized around these major areas of concentration, follow.

Expectations and support of students

What approaches for student support have been shown to be effective in communicating and sustaining standards and expectations for student achievement and learning in schools serving poor communities? What is the evidence of their effectiveness?

What challenges have remained resistant to approaches for providing support for student learning of mathematics? How might these challenges be addressed?

What were the mathematical standards defining expectations for students in schools or programs identified as being effective in poor communities? How do these standards for mathematics relate to recommendations in prior NCTM documents?

What are the key questions that need to be investigated regarding effective approaches for supporting students from poor communities in their efforts to reach mathematical expectations?

Evidence and assessment of student learning

What is the evidence of students' mathematics learning and achievement in schools that have been identified as being effective in serving students from poor communities? What mathematics assessments were used to define effective mathematics learning and achievement in these schools? What is the mathematics content of these assessments? How do these assessments for mathematics relate to recommendations in prior NCTM documents?

What are the challenges that must be considered when collecting valid and reliable evidence of students' mathematical learning and achievement at sites impacted by poverty? How might these challenges be addressed?

What are the key questions that need to be investigated regarding evidence and assessment of student learning of mathematics in schools serving poor communities?

Mathematics content relevant to students experiences and needs
What was the mathematics content being investigated by students and teachers in effective schools or programs serving poor communities? How did this content relate to students' prior experiences and existing needs, particularly in the communities in which they live?

What is the evidence of the importance of relevant contexts in supporting student achievement in mathematics, particularly in schools serving poor communities?

Mathematics Teaching and Learning

Within the strand of mathematics teaching and learning, three major areas of concentration have been identified. Initial questions to be addressed at the conference, organized around these major areas of concentration, follow.

Teaching methods and materials
What methods of teaching mathematics have been shown to be effective in schools serving poor communities? What is the evidence of their effectiveness?

What types of instructional materials, including core curriculum or ancillary materials, have been used in schools serving poor communities that show evidence of success? What is the evidence of their critical role? How do these instructional materials relate to recommendations in prior NCTM documents?

What challenges have limited the effectiveness of instructional methods and materials for teaching mathematics to students from poor communities? How might these challenges be addressed?

What are the key questions that now need to be investigated regarding methods and materials for effective mathematics teaching and learning in poor communities?

Teacher preparation and qualification
What evidence clarifies both the definition of and influence of teacher preparation and qualification on the effectiveness of mathematics instruction in schools serving poor communities?

How does the initial preparation of teachers support or inhibit effective mathematics instruction in poor communities? In particular, how did teacher preparation, with respect to each of the following, appear to be important: the mathematical knowledge of teachers, the pedagogical knowledge of teachers, teachers' knowledge of student learning, and teachers' knowledge of culturally and/or linguistically diverse student populations?

What are the key questions that need to be investigated regarding initial preparation in order to yield qualified mathematics teachers for schools serving poor communities?

Teacher professional development and support

What approaches for teacher professional development and support have been shown to be effective for teachers working in schools serving poor communities? What is the evidence of their effect?

How were the following components addressed and evaluated in successful mathematics interventions in schools serving poor communities: teachers' pedagogical knowledge, teachers' knowledge of student learning, teachers' knowledge of culturally and/or linguistically diverse students?

What role did the themes of collegiality and community play in the professional development and support of effective teachers in schools serving poor communities?

How do effective approaches and themes for teacher professional development and support relate to the recommendations in prior NCTM documents?

What challenges must be addressed when defining approaches for providing professional development and support for teachers of mathematics in schools serving poor communities? How might these challenges be addressed?

What are the key questions that now need to be investigated regarding the professional development and support of mathematics teachers in schools serving poor communities?

School, District, and Community

Within the strand of school, district, and community context, three major areas of concentration have been identified. Initial questions to be addressed at the conference, organized around these major areas of concentration, follow.

Curricular policy

What role have mathematics curriculum frameworks and other statements of curriculum policy played in enhancing the mathematical preparation of students in poor communities? What evidence describes the implications of curricular policy on student mathematics achievement? How do these effective mathematics curriculum frameworks or statements of curriculum policy relate to recommendations in prior NCTM documents?

What challenges are faced by schools serving poor communities when attempting to implement mathematics curricular policies? How might these challenges be addressed?

What are effective techniques that have been used to build community knowledge of and support for new directions in mathematics curriculum and instructional approaches? What is the evidence of the effectiveness of these techniques?

What challenges are faced when attempting to reach out to and involve parents and leaders in poor communities? How might these challenges be addressed?

How is the often limited availability of technology addressed by schools serving poor communities that are seeking to engage students and teachers in the use of technology?

What are the key questions that need to be investigated regarding the role of curricular policy in enhancing mathematics instruction and student achievement in schools serving poor communities?

School, district, and community leadership

What approaches have been successful in supporting the leadership of teachers and principals in their efforts to advance effective curriculum policies and instructional practices in mathematics? What is the evidence of their effectiveness?

What challenges inhibit the development of leadership among teachers and principals in schools serving poor communities? How might these challenges be addressed?

What are challenges that inhibit the effective use of resources? How might these challenges be met?

What approaches have been successful in advancing the awareness of and support for effective use of adequate resources by superintendents, schools, and school boards in districts serving poor communities? What is the evidence of their success?

What are the challenges that interfere with the development of a broad base of community support and leadership for mathematics enhancement in schools serving poor communities? How might these challenges be met?

What approaches have been successful in promoting community support and leadership in sustaining long-term reform and maintaining review and evaluation for adjustments to refine mathematics curricular policy and instructional enhancement within schools that serve poor communities? What is the evidence of this success?

How might NCTM support the development of leadership across all levels (classroom, school, local district, and community) in order to promote and support instructional reform and student achievement in schools serving poor communities?

What are the key questions that now need to be investigated regarding the role of school, district, and community leadership in enhancing mathematics instruction and student achievement in schools serving poor communities?

Parent and community involvement in education

What strategies have been successful in generating parental and community understanding of and support for educational change and improvement in mathematics curriculum and instruction? What is the evidence of the success of these strategies? What are the characteristics of Family Math programs that have yielded increased parental involvement in mathematics instruction and educational improvement?

What challenges must be addressed in reaching out to and maintaining effective communication and support from caregivers of students in schools serving poor communities? How might these challenges be met?

How might the business community, the public sector, and community volunteer organizations be engaged in and support mathematics teaching and learning in schools that serve poor communities?

What challenges must be addressed in reaching out to and maintaining effective support from business, public sector and volunteers? For what roles are these groups best suited?

How might NCTM support parent and community involvement at the classroom, school, and local district level in order to promote and support instructional reform and student achievement in schools serving poor communities?

What are the key questions that need to be investigated regarding how to catalyze parent and community involvement to enhance mathematics instruction and student achievement in schools serving poor communities?